FUKUTANI LAB.

[Surface and Interface Science]

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Surface and Interface Physics

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http://oflab.iis.u-tokyo.ac.jp/Main/home/home-e.html

Controlling Electrons, Spins, and Protons at Surfaces

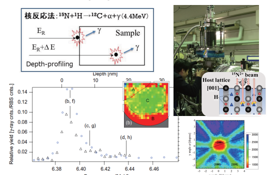
Overview

Surfaces and interfaces have different electronic states from those of bulk materials, because they have lower dimension and symmetry compared to the bulk. Thus, surfaces and interfaces are expected to reveal peculiar properties, such as interface electric conductivity and catalytic activities. From a technological point of view, surfaces play crucial roles in the formation, storage, and sensing of hydrogen that is a clean energy medium. In our laboratory, we develop novel experimental techniques to precisely observe hydrogen in aimed at elucidating the mechanisms of proton transport, electron dynamics, spin conversion and molecular hydrogen formation at surfaces, which leads to synthesis of novel functional surfaces. We also explore novel electronic properties by non-equilibrium hydrogenation of nm-thick metal/oxide films .

Experimental Techniques

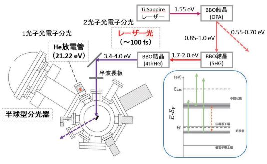
[Nuclear Reaction Analysis]

3D imaging of H in materials



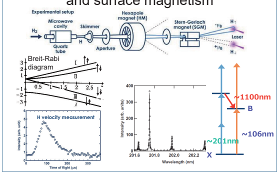
[(2-photon) Photoemission]

Electronic ground and excited states



[Spin-polarized H and Laser spectroscopy]

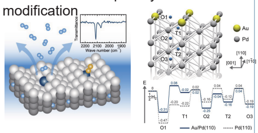
Spin conversion, rotational relaxation and surface magnetism



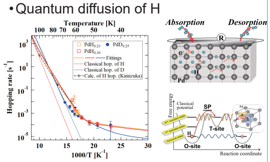
STM, Thermal desorption spectroscopy, Infrared absorption spectroscopy, etc.

Dynamics of protons, electrons, and spins

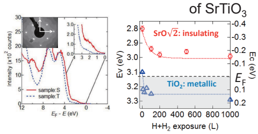
• Control of H transport by surface modification



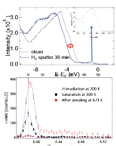
• Quantum diffusion of H

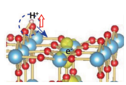


• H-induced metal-insulator transition of $SrTiO_3$



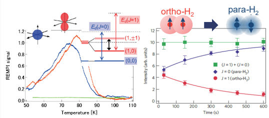
• Proton-electron separation and H diffusion at TiO_2





Small polaron & electric dipole layer formation Effects on H diffusion

• Hindered quantum rotation and nuclear-spin triplet-singlet transition



• Magnetic canting at surfaces